The Itzama project: sustainable indigenous development based on the ethnobotanical garden and traditional medicine concept

Final Report

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by

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Introduction

The Itzama project is an initiative begun with indigenous Maya in Belize that is built on the premise that traditional botanical and medicinal knowledge could be utilized as a vehicle for culturally appropriate development and the promotion of community health and wellness in the context of conservation of culture and biodiversity. Preservation of biodiversity and culture go hand in hand and provide the best basis for indigenous societies to move into a stable future. Indeed, we as a global people depend on this delicate transition as well. Our indigenous partners suggest that to be successful, development in indigenous communities needs a culturally appropriate methodology and the full involvement of community elders. This project has been operating for about a decade and involves many issues that affect indigenous communities worldwide such as protection of traditional botanical knowledge and local diversity, inclusion of community elders, re-establishing links between community members especially elders and youth, advancement of recognition of traditional medicine in Belize and promotion of sustainability through the establishment of cooperatives and indigenously owned and operated “green” microenterprises. At the core of the project is the Belize Indigenous Training Institute (BITI) and Kekchi Healers Association (KHA), the Itzama Ethnobotanical Garden (IEG), Indian Creek, Belize and the Maya Mountains Ethnobotany and Ecology Project (MMEEP). The project has been managed by the NGO, Belize Indigenous Training Institute, with collaborative assistance of University of Ottawa, Cleveland State University and Inuit Circumpolar Council.

Overall goal of current proposal

Feasibility study and pilot for sustainable indigenous development based on the ethnobotanical garden and traditional medicine concept:

Rationale and specific objectives of the current proposal.

While our previous retrospective research project showed that the development model based on medicinal garden concept and traditional healing was in the view of the Maya, a successful and promising model for development in indigenous communities, action is needed to consolidate it as an ongoing and sustainable activity. The ethnobotanical garden infrastructure is in place, and traditional medicine practice is well organized and documented, but the next generation must be trained, community outreach coordinated, and microenterprises developed. Key concerns identified by the healers themselves, were the need for respect and inclusion of traditional healing in Belize health care and a greater regard for the sanctity of the land. Both of these concerns are being directly addressed in this research.

The proposed activities included training and integration of youth and women, development of microenterprises, such as ecotourism, small scale production of validated medicinal plant products, and progress to formal remunerated participation of healers in officially recognized complementary health care activities in Belize. While methods for medicinal plant microenterprises are accessible and straightforward (especially to the N. American partners who have years of experience in the area), their application in indigenous communities is challenged by lack of capacity. Through the Belize NGO BITI, we propose to explore the best ways to develop that capacity. Victor Cal, the Director of BITI proposed that working through the local Maya high schools and local

women's groups as well as strategic workshops (as Itzama was begun) could provide the best models.

Official recognition of traditional medicine by the local medical community is hampered by lack of validation of safety and efficacy of traditional medicine. In our retrospective study with the healers, one of their most frequent requests was the scientific validation of their traditional medicine, so that it receives the respect of the western trained medical community. We therefore proposed the use of quantitative ethnobotany to select key medicinal plants with the healers for validation of medicinal activity at the University of Ottawa laboratory (Arnason). We validated anti-inflammatory products for arthritis, and other minor inflammatory conditions, since the Kekchi healers have considerable expertise in this area and it is also considered an appropriate area for self medication by regulatory authorities. The second group was suggested by the healers themselves and these are plants for anxiety and mild depression. The third group is a broad search of other agents including topical anti-infective agents, such as products used for minor fungal or bacterial infections like athletes foot, or impetigo which are also widely and successfully used by the healers. We tested the hypothesis that healer consensus is a good predictor of medicinal activity. These traditionally used medicines were further assessed for safety using the TRAMIL and other databases and considered by the same criteria for approval under Natural Health Product regulations for self care use in Canada.

While the Canadian and other partners have the research capacity and interest in pursuing this validation research, the need for ongoing protection of Maya traditional knowledge is evident, yet there is as yet no specific practical protocol in use to achieve

this protection. We proposed to develop clear simple protocols to facilitate the Intellectual Property (IP) issues not only in the current project but as a model for the access and benefit sharing process generally. This section was headed by Kevin Knight who has over 20 years experience representing indigenous intellectual property issues.

While Complementary and Alternative Medicine (CAM) systems for inclusion of traditional medicine in modern health care were approved in principle by local health authorities, and are now endorsed by WHO internationally and for Belize specifically, this approach has not been seriously implemented as yet. It is in process, however, as directly facilitated by Itzama. Todd Pesek, MD who is a specialist in cross cultural healing, ethnobotany and ecosystems health continued project efforts toward select integration of traditional healing in national healthcare supplanted by and reciprocally supportive of regional ecosystems and environmental health. We also continued development of the groundwork for specific protocols for such as a model internationally via workshops and assessments.

To achieve the above, we now report on the following **specific objectives**:

Objective 1. to support the development of indigenous cultural and economic micro-enterprises based on the ethnobotanical garden/traditional medicine concept;

Objective 2. to produce a practical proactive draft protocol for indigenous intellectual protection;

Objective 3. to validate Maya botanicals through quantitative ethnobotany;

Objective 4. to explore how best to include traditional healing into front line modern health care protocols and community health and wellness.

Achievement of Objectives:

The objectives were achieved successfully, largely as described in the program of the IDRC proposal, with Victor Cal managing local Belize activities, Kevin Knight developing the Access and benefit sharing protocol, J Arnason and graduate students undertaking medicinal plant activates and T Pesek undertaking the Complementary Medicine activities. One minor change in the programming was to replace a local agronomist with a Canadian volunteer, Patrick Audet and by increased role of the healers, since we were unable to attract a qualified local candidate for a short term project in this remote area.

Objective 1. to support the development of indigenous cultural and economic micro-enterprises based on the ethnobotanical garden/traditional medicine concept;

1 a. Market scan for medicinal plants

A survey of local medicinal products for sale in villages and towns in the Toledo district of southern Belize was conducted. This survey revealed that Maya villages have relatively few medicinal products for sale in local stores. Villagers desiring natural medicinal products directly seek the services of traditional healers, who perform healing ceremonies, administer treatments, and supply patients with natural medicines for continued use. The only natural medicinal products found for sale were sold in Punta Gorda, the largest town in Toledo. Natural remedies are sold by general herbalists, who

have a basic understanding of common medicinal plants and their preparation, and who often sell their own personal formulations of well known astringent plants referred to as "bitters" such as jackass bitters (*Neurolaena lobata*). A small variety of natural medicinal products are also for sale in the Punta Gorda market. These include products sold purely for their medicinal uses, products sold for ceremonial uses in healing rituals, and products sold as medicinal foods. Mansaneya (Creole), pericon (Spanish), ruda (Spanish) (*Ruta graveolens*), and sorosi (Spanish) (*Momordica charantia*) are sold in fresh or dried bundles for use as medicinal teas in the treatment of common ailments such as fevers and headaches. The dried bundles of these plants, as well as copal resin (*Protium copal*), are also sold for use as medicinal incenses in healing ceremonies. One additional medicinal natural product for sale in the local market, of animal origin, was shark oil, to be used in the treatment of bone and joint ailments. When asking market vendors if they sold any medicines, the bulk of natural products with purported medicinal benefits were sold as medicinal foods. These include amaranth (*Amaranthus dubius*), balu (Creole), basil (*Ocimum basilicum*), cacao (*Theobroma cacao*), cassava (*Manihot esculenta*), celo (Creole), coriander (*Eryngium foetidum*), garlic (*Allium sativum*), ginger (*Zingiber officinale*), ocra (*Abelmoschus esculentus*), onions (*Allium cepa*), oregano (*Lippia graveolens*), pala (Creole), plantain (*Musa paradisiaca*), tamarind (*Tamarindus indica*) and yams (*Dioscorea* sp.). The medicinal natural products for sale mainly consist of easily accessible plants which grow in agricultural environments, costal areas, fallow fields or in disturbed secondary rainforest habitats. No plants from inland or mountainous primary rainforest, the main areas used by the Q'eqchi' traditional healers to collect medicinal plants, were sold in the Punta Gorda market.

As a result of the market scan and discussions with the healers., a new **"Handbook of Q'eqchi' Maya Phytomedicines and Botanical Products"** was prepared **(appendix 1).** This handbook emphasizes, traditional Maya and Belize botanicals which the healers considered public domain and suitable for commercialization. A decision was made to include only plants with a high measure of safety. The handbook includes information on uses, pharmacology and toxicology prepared by the University researchers. The handbook was used in objectives 1b and 1c as a training document for local use.

To encourage local ecotourism to the garden, we met with local hotel owners to invite them to visit the garden with guests on a guided reservation basis. A description of the Garden and its activities was written and published in the local newspaper **(see appendix 1: Toledo Howler article)**

Objective 1 b Training and capacity building: agronomy

Two participatory workshops were held with Q'eqchi' healers, students, and women in order to build capacity in medicinal plant agriculture and medicinal plant processing technology. The first capacity building activities which focused on medicinal plant agriculture took place at the Itzamma ethnobotanical garden throughout the month of May, 2009. PhD candidate in Plant Science from the Charest lab, Patrick Audet and 2 graduate students in Medicinal Plant research, Brendan Walshe Roussel and Jonathan Ferrier stayed at the garden during this epriod. Discussions were held with members of the Q'eqchi' Healers Association, who are responsible for maintaining and expanding the Itzamma ethnobotanical garden with the support of the Belize Indigenous Training Institute (BITI) coordinated by Victor Cal. These discussions surrounded the concepts of

permaculture and biodiversified agroforestry with a focus on garden intercropping, forest regeneration, potential commercially viable crops, and sustainable harvesting. The Itzamma garden consists of an open field site and a managed secondary rainforest site. As part of the Itzamma development planning, the entire garden was mapped and cultivated species were catalogued. Interviews were conducted with the Q'eqchi Healers Association in order to document the observed transplantation effectiveness and the current physiological status of cultivated medicinal plants. A draft research document describing the biodiversity resources of the garden, challenges and solution to this novel approach to indigenous development are described in **appendix 1**, "**Indigenous Biological Conservation of Medicinal Plant Resources at the Itzamma Garden: Status and challenges"**

The open field site contains a variety of ornamental species, fruit tree species, large medicinal shrub species, and rows of lemon grass (*Cymbopogon citratus*). In order to improve soil quality and insure sustainable plant culture, intercropping techniques were discussed and a plan for implementation was developed. To facilitate the initiation of this plan, the crop of lemon grass was expanded and a variety of Fabaceae tree species were intercropped with the rows of lemon grass. Species belonging to the Fabaceae family are commonly used intercropping species due to their ability to form symbiotic relationships with nitrogen-fixing bacteria which can greatly contribute to soil fertility. In addition, tree species selected for intercropping were fast growing, drought tolerant, and capable of generating large amounts of leaf litter. Also, three test plots of German chamomile (*Matricaria recutita*) were established in the open field portion of the garden as a potential commercially viable crop. With regards to the managed secondary

rainforest portion of the garden, the focus was on active forest regeneration and on expanding the existing under-story ginger crop. As a consequence of the 2001 hurricane Iris, many of the large emergent canopy species in the garden were destroyed, transforming a relatively mature primary rainforest site into a disturbed secondary rainforest site with a lower and more sun-permeable canopy, hence increasing temperatures and decreasing moisture content at ground levels. The cultivated tropical ginger (*Zingiber officinale*) prefers semi-shaded moist soils, therefore restoring the rainforest canopy is essential to producing a healthy and sustainable ginger crop. Discussions with members of the Q'eqchi' Healers Association also focused on techniques which would facilitate the regeneration of a mature forest canopy. These included the planting of ground covers to reduce soil temperatures and help retain moisture, the planting of large hardwood species that would provide canopy height and shade, and the active management of canopy gaps where emergent tree species could be preferentially nurtured. In addition, replacing rapidly decaying fallen logs which serve as temporary epiphyte habitats with more permanent raised beds was proposed. The final improvement made to the Itzamma medicinal garden was the replacement of a latrine with one suitable for female members of the community and guests who wish to visit the garden.

In our formal research report on this activity, we have prepared a detailed analysis of the Izamma Ethnobotanical Garden as a culturally appropriate approach to indigenous development. Clearly, the indigenous garden has its challenges, but the commitment and energy of the healers in this activity were very encouraging and shows that it is a successful model for indigenous development.

1 c Training and capacity building: medicinal plant use

A second workshop on medicinal plant products took place on June 24th, 2009 at the Tumul K'in Centre of Learning in Blue Creek, Toledo. The workshop was organized with the assistance of Esther Sanchez Sho, the managing director of Tumul K'in, and Victor Cal, a senior instructor at Tumul K'in and the coordinator of BITI. The workshop was attended by students specializing in agro-processing, staff working in the agro-processing facilities, instructors, the agro-processing program director and the coordinator of the Q'eqchi' Healers Association. A powerpoint presentation, entitled **Kechi Maya Botanicals (Appendix 3)** was presented and notes for the workshop left with the teachers. A brochure containing information on the traditional uses, preparation methods, and the reported bioactivities of well known local medicinal plants was prepared for the workshop **(Appendix 1).** Plant species suggested as suitable candidates for medicinal plant products included cat's claw (*Uncaria tomentosa*), ginger root (*Zingiber officinale*), guava leaf (*Psidium guajava*), jackass bitters (*Neurolaena lobata*), lemongrass (*Cymbopogon citratus*), and pimenta leaf (*Pimenta dioica*). The workshop also contained information on the cultivation and processing of medicinal plants, the production and marketing of medicinal plant products, safety concerns, and sustainability issues. Activities included the processing of dried medicinal plants using a grinder and sieve; the production of medicinal tea bags and of medicinal plant bulk bags; the production of a medicinal plant alcohol tinctures and the production of balms and slaves containing medicinal plant ingredients. Using examples of medicinal plant products sold in Canada, the workshop demonstrated the packaging of medicinal plant products, labels used for medicinal plant products, and inserts included in boxes or bags of medicinal

plant products. Relevant information from the medicinal plant brochure was suggested to be included on packaging of potential medicinal plant products. The Tumul K'in Centre of Learning was also provided with a start-up quantity of tea bags and bulk bags, several tincture bottles, salve jars and salve ingredients beeswax and oil, and boxes for medicinal plant products. Overall, the workshop was well received and actively participated in, and it generated positive feedback. To formalize the association between the Itzamma garden and the school, a draft memorandum of agreement was prepared on benefit sharing with respect to medicinal plants. The traditional knowledge course at the school now emphasizes the role of traditional medicine and uses the botanical garden and the healers association as a key teaching resource.

Objective 2. to produce a practical proactive draft protocol for indigenous intellectual protection;

2a Education of healers, government officials.

Kevin Knight met with the healers and members oat the Izamma Garden in May 2009 to discuss traditional knowldege, their intellectual property rights and the draft protocol for bioprospecting an scientific research. The healers agreed that their traditional knowledge should be protected from third party exploitations, but they are prepared to share their medicinal knowledge freely if it can help people. Arnason and Pesek also met with the deputy Chief Forest Officer, Marcelo Windsor, to explain the protocol development and he indicated that it would be very useful in addressing the Belize response to the convention on biological diversity.

2b development of the protocol

The draft protocol was prepared as a stand alone document **"Bioprospecting and research: a protocol"** by Kevin knight after consultation with all parties and is provided in **appendix 2** . This protocol provides a specific protocol for the Izamma project and a general model for intellectual property protection for indigenous groups /r governments.

3 a. Ethnobotanical research

Ethnobotanical information was collected by Brendan Walshe Roussel through a series of open-ended interviews and botanical collecting trips with members of the Q'eqchi' Healers Association, where participating healers have prior informed consent and agreements to protect intellectual property rights are in place. Healers were interviewed individually, and asked about a series of 14 inflammatory symptoms (Table 1), and the plants used to treat them. Interviews were conducted in English, Spanish, and Q'eqchi', with the assistance of a Q'eqchi' translator. This project was approved by the University Research Ethics committee (File H 03-07-01).

Table 1 – Inflammatory symptoms used during ethnobotanical interviews.

Symptom Title	Symptoms, descriptions, and causes
Allergies	Runny nose, itchy eyes, sneezing
Boils	Boils on skin, caused by infections and impure blood
Hot/cold swelling	Swelling and pain caused by rapid hot/cold transition
Evil spirit swelling	Swelling and pain caused by evil spirits
Fever	Excess heat and chills
Insect bites	Insect bites and stings on skin
Snake bites	Snake bites on skin
Arthritis and rheumatism	Stiff, swollen, or painful joints
Rash	Rash, redness, or itchiness on skin
Common cold	Sore throat and coughing, yellow/green thick mucus
Stomach cramps	Cramps in stomach
Fast breathing/heart	Elevated breathing rate and/or heart rate
Ulcers and heartburn	Burning in stomach
Headache	Headache

In total, eighty-two species belonging to thirty-seven families were identified during the ethnobotanical interviews (Table 2). The three most important families used as immunomodulatory medicines were the Piperaceae (21 species), the Asteraceae (8 species), and the Rubiaceae (5 species). Three voucher specimens, dried plant samples and plant samples preserved in alcohol were collected for each species.

Table 2 – Eighty-two Q'eqchi' medicinal plants identified during ethnobotanical interviews. Plant family, genus species, and Q'eqchi names are presented along with plant part used (A = aerial parts, B = bark, L = leaf, R = root, S = stem, W = whole plant), location collected (I – Itzamma garden, J = Jalacte, P = Punta Gorda), and habitat collected in (1° = primary rainforest, 2° = secondary rainforest, 1° - 2° = secondary to primary transitional rainforest). The taxonomical identifications provided and the spelling of the Q'eqchi plant names are subject to revision.

Family	Genus species	Q'eqchi name	Plant part	Location	Habitat
Acanthaceae	*Justicia albobracteata* Leonard	Ixcua'i'kok	L + S	J	1°
Acanthaceae	*Justicia pectoralis* Jacq.	Santa Maria kejen	L + S	J	1° - 2°
Acanthaceae	*Justicia* sp.	Jolom chacmut (#1)	L	J	1° - 2°
Acanthaceae	*Justicia* sp.	Jolom chacmut (#2)	L	J	1° - 2°
Acanthaceae	*Justicia* sp.	Jolom chacmut (#3)	L	J	1° - 2°
Acanthaceae	*Justicia* sp.	Jolom chacmut (#4)	L	J	1° - 2°
Adiantaceae	*Adiantum wilsonii* Hook.	Ruj'i'rak'aj'tza	L + S	J	1°
Adiantaceae	*Aphelandra sp.*	Roq chit cuan (#2)	L + S	J	2° riverbank
Adiantaceae	*Pityrogramma calomelanos (L.) Link*	Roq chit cuan (#1)	L + S	J	2° riverbank
Amaranthaceae	*Iresine diffusa* Willd.	Biri tak	L + S	J	1° - 2°
Apocynaceae	*Echites sp.*	Chaj max, Posp	A	I	2° garden
Araceae	*Anthurium willdenowii* Kunth.	X'chich maus	L	J	1°
Araceae	*sp.*	Kon chi	L	J	1° - 2°
Araceae	*sp.*	Letzeb	L	J	1° - 2°
Araceae	*sp.*	Mai pim (#2)	L	I	2° riverbank
Araliaceae	*Dendropanax arboreus* (L.) Decne.& Planch.	Cojl	L + S	J	1° - 2°
Aristolochiaceae	*Citrus limetta* Risso	Rok maus, Xa'ab maus	L + S	J	1°
Aspleniaceae	*Elaphoglossum herminieri* (Bory ex Fée) T. Moore	Rubelsa ixul	W	J	1° - 2°

Asteraceae	*Baccharis trinervis* Pers.	Chere sac	L + S	J	2°
Asteraceae	*Columnea sp.*	Juruch aj pak	L	J	1° - 2°
Asteraceae	*Columnea sp.*	Juruch aj pak	S	J	1° - 2°
Asteraceae	*Neurolaena lobata*	Kan monk	L	I	2° garden
Asteraceae	*sp.*	Iqbolie pim	L + S	I	2° roadside
Asteraceae	*sp.*	Kari chun	L + S	I	2° garden
Asteraceae	*sp.*	Rixij tzunun	R	J	1°
Asteraceae	*Vernonia stellaris* La Llave & Lex.	Hob'lob'te	L	J	1° - 2°
Begoniaceae	*Begonia glabra* Aubl. var. Glabra	Pa'ulul	L	J	2°
Begoniaceae	*Begonia heracleifolia* Schltdl.& Cham..	Xak pek	L	J	1°
Burseracea	*Bursera simaruba*	Rix kakajl	B	I	2° garden
Cactaceae	*Epiphyllum phyllanthus* (L.) Haw. var *strictum* (Lem.) Kimnach	Chic'ba'bac	L	J	1°
Cucurbitaceae	*Gurania makoyana* (Lem.) Cogn.	Kum pim	L + S	J	1° - 2°
Dracaenaceae	*Dracaena americana* Donn. Sm.	Tut	B	J	1° - 2°
Euphorbiaceae	*Croton xalapensis* H. B. K.	Noqte	L	I	2° garden
Fabaceae-Mimosoideae	*Bolbitis pergamentacea* (Maxon) Ching	Quare kix	L + S	J	1° - 2°
Fabaceae-Mimosoideae	*sp.*	Chok lok te	L + S	J	2°
Gesneraceae	*Besleria* sp.	Jolom masan	L	J	2° riverbank
Gesneriaceae	*Guarea grandifolia* DC.	Bak nel pim	L + S	J	2°
Haemodoraceae	*Xiphidium caeruleum* Aubl.	Ixcua'i'kuch	L	J	1° - 2°
Lamiaceae	*Hyptis capitata* Jacq.	Se ruj kaway	L	I	Open yard
Loranthaceae	*Aphelandra sp.*	Neba pim	A	I	2° garden
Malvaceae	*Sida acuta* Burm. f.	Mes b'eel	L + S	I	Open yard
Marcgraviaceae	*Souroubea gilgii* V.A. Richt.	Hub'ub	L	P	2°
Mimosaceae	*Acacia* sp.	Rix subin	B	I	2° garden
Monimiaceae	*Mollimedia guatemalensis* Perkins	Saki kejen, Saki pim	L	J	2°
Oleandraceae	*Stachytarpheta frantzii* Pol.	Ixqu'oq mo'coch	L	J	1° - 2°
Orchidacea	*sp.*	Chacbolie kejen, Chacbolie pim	L + S	J	1° - 2°
Papilionaceae	*Desmodium adscendens* (Sw.) DC.	Chint pim	L + S	J	1° - 2°
Passifloraceae	*Passiflora guatemalensis* S. Watson	Tukej kejen	L	J	Milpas
Piperaceae	*Aristolochia sp.*	Xe'ubel	R	I	2° garden

Piperaceae	*Justicia pectoralis* Jacq.	Ixcua ajaw chan	L	I	2° riverbank
Piperaceae	*Peperomia hipidula* (Sw.) A. Dietr.	Ixcua'i'xul (#1)	W	J	1°
Piperaceae	*Peperomia sp.*	Ixcua'i'xul (#2)	W	J	1°
Piperaceae	*Peperomia sp.*	Mai pim (#3)	L	I	Open yard
Piperaceae	*Peperomia tetraphylla* (G. Forst.) Hook. & Arm.	Pu'chuch re'tzul	L	J	1°
Piperaceae	*Piper amalago* L.	Tzi'ritok	L + S	J	1° - 2°
Piperaceae	*Piper peltatum* L.	Tyut'it	W	J	1° - 2°
Piperaceae	*Piper schiedeanum* Steud.	Tyut'it pu'chuch	L	J	2°
Piperaceae	*Piper sp*	Cacao pim	W	J	1°
Piperaceae	*Piper sp*	Pu'chuch rebakel	L	I	2° garden
Piperaceae	*Piper sp*	Saki tyut it	L	J	2°
Piperaceae	*Piper sp*	Saki tyut it	S	J	2°
Piperaceae	*Piper sp*	Saki tyut it	R	J	2°
Piperaceae	*Piper sp.*	Pu'chuch re'much kej	L	J	1°
Piperaceae	*Piper tuerckeimii* C.DC. ex Donn. Sm.	Cux sawi	L + S	J	1°
Piperaceae	*Piper tuerckeimii* C.DC. ex Donn. Sm.	Cux sawi	R	J	1°
Piperaceae	*Piper tuerckeimii* C.DC. ex Donn. Sm.	Cux sawi	S	J	1°
Piperaceae	*Piper yucatanense* C. DC.	Tzu'lub pim	L	J	1° - 2°
Piperaceae	*sp.*	Jol jol	L	J	1° - 2°
Piperaceae	*sp.*	Ton kit	L	J	1° - 2°
Poaceae	*sp.*	Mes iha, Qiskim iha	A	I	2° garden
Rubiaceae	*Gonzalagunia panamensis* (Cav.) K.Schum.	Tzu'ul che	L	J	2° riverbank
Rubiaceae	*Hoffmannia sp.*	Mai pim (#1)	L + S	J	1° - 2°
Rubiaceae	*Psychotria* sp.	Kolaras	L + S	J	1° - 2°
Rubiaceae	*sp.*	Kek'ek ux	L + S	J	1° - 2°
Rubiaceae	*sp.*	Na'i'pajl	L	I	2° garden
Sapindaceae	*Paullinia sp.*	Korona kix	L	J	2°
Schizaeaceae	*Lygodium heterodoxum* Kunze	Rux'bi'kaak (#1)	L	J	2°
Schizaeaceae	*Lygodium venustum* Sw.	Rux'bi'kaak (#2)	L	J	2°
Selaginelliaceae	*Selaginella umbrosa* Lem. Ex Hieron.	Choql pim	L	J	1° - 2°
Solanaceae	*Cornutia pyramidata L.*	Ik che, Ik kejen	L + S	J	1°
Solanaceae	*Solanum rudepanum* Dunal	Pajl	L	I	2° garden
Verbenaceae	*Cornutia grandifolia* (Schltdl. & Cham.)	Rok xa'an	L + S	J	1° - 2°

	Schauer				
Verbenaceae	*Hyptis sp.*	Xtye aj pak	L	I	Open yard
Verbenaceae	*Lantana trifolia* L.	Tu lush	L	J	1° - 2°
Verbenaceae	*sp.*	Se ruj ajaw chan	L	J	1° - 2°
Zingiberaceae	*Renealmia sp.*	Cux tzi	L	J	2°
Zingiberaceae	*Zingiber officinale*	Xi lix	R	I	2° garden

3b. Medicinal use compared with Laboratory research: relation of traditional and modern science.

This section was supported under NSERC funding using the plants collected ethnobotanically. Brendan Walshe Roussel evaluated anti-inflammatory and antimicrobial activity as described in **appendix 3a**. Preliminary result show that the ethnobotanically selected plants are active in these assays. A new published study by our group shows that there is a strong statistical correlation between frequency of use of plants for epilepsy and anxiety and relevant pharmacological activity. (Appendix 3). The results confirm that traditional knowledge can be validated by modern scientific knowledge.

Objective 4. to explore how best to include traditional healing into front line modern health care protocols and community health and wellness.

This achievement of this objective is reported in detail **in appendix 4 "Inclusion of Traditional Maya Healing in Health Care" by Todd Pesek**. A summary follows:

4a environmental scan of traditional medicine inclusion projects, potential for success of inclusion strategy, report on similar projects

In short, there are very few representative inclusion projects sufficiently documented in the literature. However, the potential success for such a strategy is clearly demonstrated by several related phenomena including Traditional Healing and Complementary and Alternative Medicine implementation and utilization trends globally as well as their associated market forces.

4b discussion with healers, health authorities on inclusion, preparation and plan for workshop

In short, it was the initial intention to host a workshop with Ministry of Health officials and QHA, but the researchers learned early on that it would be more productive to host a community workshop and then conduct a series of interviews and meetings with healers and officials thereafter which would then convey the sentiment of the QHA and communities to the highest reaches of the government in Belize.

4c workshop, plan for inclusion of traditional medicines, workshop report and recommendations

In short, successful integration will require the involvement of the community elders in delineating action. It will also require close collaboration between the healers and relevant stakeholders in community and leadership structures in community, healthcare, and government Belize.

Conclusions:

The inclusion of traditional medicine in modern medical care and CAM was approved in principle by local authorities in Belize, and is now endorsed by WHO internationally, and for Belize, specifically as we move forward in our programming it is essential that we focus on: generational transmission of knowledge; involvement of the community elders in delineating action; close collaboration between the healers and relevant stakeholders in community and leadership structures in community, healthcare, and government in Belize; and protection of the natural resources through education, community involvement, and carefully planned action.

Outcomes and lessons learned:

Through these development research activities, we learned that indigenous communities require a distinct development model from other mainstream communities. To indigenous Maya and other First Nations, medicinal plants are sacred and community resource. Their priorities are both spiritual and pharmacological healing, as well as conservation of biodiversity and culture. The cultivation and use of medicinal plants brought elders and youth together, in a positive interaction and stimulated genuine commitment form both groups . The ethnobotanical garden is a viable development model, developing new initiative s in ecotourism and medicinal plant production. Opportunities for microenterprises are real but require longer development to create significant economic activity.

Appendices

Appendix 1. a) Kekchi Maya Medicines and Botanical products (Brochure) by Jonathan Ferrier et al

b) Toledo Howler ecotourism article by Victor Cal et al.

c) Powerpoint presentation on Kekchi Maya botanicals.

d) Indigenous Biological Conservation of Medicinal Plant Resources the Itzamma Garden, by Patrick Audet

e) Q'eqchi' Maya healers' traditional knowledge in prioritizing conservation of medicinal plants by Todd Pesek et al.

Appendix 2 Biodiversity and Scientific research: a protocol, by Kevin Knight

Appendix 3a. Medicinal use compared with Laboratory research on antiinflamatory and anti-infective plants. By Brendan Walshe Roussel

3b. Ethnopharmacology of Q'eqchi' Maya antiepileptic and anxiolytic plants: Effects on the GABAergic system, by Rosalie Awad et al

Appendix 4. Inclusion of Traditional Maya Healing in Health Care" by Todd Pesek.